VERIFICATION OF FORCE AND ACCELERATION SPECIFICATIONS FOR RANDOM VIBRATION TESTS OF SPACECRAFT EQUIPMENT

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A new, more realistic method of controlling random vibration tests of spacecraft equipment was presented at the 1994 Conference on Spacecraft Structures Materials and Mechanical Testing in Paris. In the new method, both the Shaker acceleration and force are controlled. The input acceleration is automatically notched at the equipment resonances by limiting the shaker forces to values predicted for flight. Ideally, the acceleration and force specifications for the equipment random vibration tests would envelope the peaks in the spacecraft/equipment interface environment during the launch, with a desired test margin. Herein, interface acceleration and force data measured in the acoustic tests of the CASSINI spacecraft development test model (DTM) are compared with the equipment random vibration test specifications.

During the past two years, force limiting has been used in the random vibration tests of many of the equipment items mounted on the CASSINI spacecraft. The force limits were derived using two degree-of-freedom models together with apparent mass data for the equipment and for the spacecraft, as previously described in the 1994 conference. Three acoustic tests have been performed on the CASSINI spacecraft development test model (DTM) with different model and equipment configurations. The acceleration and force spectra at the interfaces between the equipment items and the spacecraft DTM structure were measured in the acoustic tests and compared with the equipment random vibration test specifications. In addition, the spacecraft apparent mass was measured at the equipment mounting points on the DTM structure and used in the force limit prediction methods. The predicted force limits are shown to be conservative with respect to (greater than) the measured limits. Thus the force prediction methods have been verified. Comparison of the interface acceleration levels measured in the acoustic tests with the equipment random vibration specifications indicated that the acceleration specifications were also conservative, but not unduly so, in the majority of cases.